May 1970

Brief 70-10273

NASA TECH BRIEF

Lightweight, High-Strength, Reinforced Plastic Tube-Franging Die

Energy absorption by tube franging (the breaking of a tube at a predetermined rate by an impact load) has been considered for soft-landing of air-dropped payloads. A similar application is the collapsing steering column in motor vehicles. However, in the case of the air drop, two important considerations exist that are not involved in the motor vehicle: light weight and rf transparency (in the case of radio transmitting or receiving equipment).

Previously, metal tubes and franging dies (see NASA Tech Brief 63-10304) have been used, but neither the aluminum frangible tube nor steel die is rf-transparent and each imposes a weight penalty. The importance of the dies cannot be overemphasized since they distribute the shock loads to the tube ends, and must be designed so that maximum use of the tubes' shock-absorbing capacity is realized.

In certain air-drop planning, a target compressive franging stress of 20,000 psi was required for the shock-absorbing tubes, and a compressive strength above this value had to be used for the material. Low-cost cast epoxy dies were considered inadequate, but a commercially available phenolic molding compound with chopped glass fibers as fill material was found to meet weight and strength requirements. Matched die metal molds were used, and the die material was subjected to a molding pressure in compression between 200 and 2,000 psi at temperatures between 290° and 340° F, with a cure time of 2 min.

Notes:

1. Mechanical properties of dies of this material are: a flexural strength of 20,000 psi and a compressive strength of 28,500 psi.
2. Tube-franging action with these dies is as good as that obtained with steel dies six times as heavy, and the franging groove remains polished and undeformed after repeated tests.
3. This technique would be useful as a shock-absorbing medium for highway guard rails where the rustproof property would reduce maintenance.
4. The following documentation may be obtained from:

   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference:
   NASA-CR-66301 (N67-21178), The Design and Development of Radio Frequency Transparent Omnidirectional Energy-Absorbing Element Systems

Patent status:

No patent action is contemplated by NASA.

Source: Ronald H. Smith, Harold Caseldine, and Sellers Bush of
The Northrop Corp.
under contract to
Langley Research Center
(LAR-10126)

Category 04